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EVOLUTION AND STRUCTURAL CHANGE OF THE COSTA RICAN BANKING SYSTEM

RESEARCH PROPOSAL

by

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by

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1. INTRODUCTION

Over the past four decades, the Costa Rican banking system has been dominated by government-owned banks. This has been a consequence of the nationalization decree of 1948, according to which government-owned banks became the only intermediaries authorized to mobilize demand deposits from the public. For a country with an undeveloped financial system, this monopsony in the market for deposits, enjoyed by the four nationalized banks, permitted their supremacy in the financial system.

It was not until the most recent decade, when a process of financial deregulation and financial innovation began, that a small fringe of private banks made their incursion into the industry. Over the past few years, this industry has experienced significant structural changes, that deserve to be studied in their causes and consequences. In addition, the field of Industrial Organization has undergone important changes. Many new approaches and techniques, along with the revival of some old approaches, have broadened the areas of potential research and have revitalized theorical and empirical controversies.

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[1] This research proposal presents a detailed design of a study of competition in the Costa Rican banking system, as part of the Financial Services Project, financed by the Agency for International Development (USAID), and implemented by The Ohio State University and Academia de Centroamerica. This research efford is part of the author's doctoral dissertation in the Department of Economics at Ohio State, under the direction of Prof. Claudio Gonzalez-Vega, the Project's Principal Investigator.

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New trends in the field of Industrial Organization criticize the Structure-Conduct-Performance paradigm for being deterministic, overstressing the role of market structure and understressing the role of conduct. The emergence of the New Empirical Industrial Organization calls for a shift from the industry to the firm as the primary unit of analysis. It asks for research at the intra-industry rather than the inter-industry level, emphasizing the use of time series data from single industries, and highlighting the role of conduct as a prominent variable in the determination of an industry's structure and the performance of firms.

Besides, the revival of the Austrian School, together with the Evolutionary Theory, ask for a greater interest in the dynamic aspects of the evolution of an industry's structure, where the structure is neither exogenous nor static, and where the equations of motion receive more attention than the static notion of equilibrium. Significant structural transformation in the Costa Rican banking industry, together with changes in the field of Industrial Organization, motivate the proposed study.

The purpose of this proposal is twofold. First, sections 2 and 3 analyze the consequences of the nationalization decree and describe the evolution of the structure of the Costa Rican banking industry. Special emphasis is placed on the 1980s, when a significant structural change, characterized by the entry of small private banks and the steady decline of concentration indices, took place. It is shown that the evolution of the Costa Rican banking industry contains interesting features.

Second, in accordance with recent developments in the field of Industrial Organization, the main hypotheses are developed and the econometric techniques to test them are presented in sections 4, 5, and 6. Special emphasis is given to Markov stochastic

processes and to clustering techniques, because of their usefulness to analyze dynamic situations and the firms' strategic behavior, respectively. A final section discusses the data needed for the empirical analysis.

2. THE NATIONALIZATION OF THE COSTA RICAN BANKS

In 1948, a few months after a two-month civil war, the new provisional Government - the *Junta*- dictated a decree nationalizing the largest banks of the country. The true reasons behind this nationalization are still motive of controversy[3]. The nationalization decree stated:

> *"Private Banking is nationalized. Only the state will be authorized to mobilize, through its own institutions, the deposits of the public."*[4]

This nationalization implied a monopsony in the mobilization of deposits from the public for the four government-owned banks. It did not affect financial intermediation at large[5]. It did not become illegal to operate private banks, but rather for private bankers to mobilize deposits from the public. It was still possible for private bankers to participate in the industry with non-deposit funds. The decree has not been free of criticism and reform initiatives. Some modifications to the related legislation were made in the following decades; nevertheless, the structure of the banking industry in Costa Rica remained almost intact until the 1980s.

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[3] Ortuño (1963) and Gonzalez-Vega and Mesalles (1988) provide an excellent examination of the nationalization of the banking system in Costa Rica.

[4] See Gonzalez-Vega and Mesalles (1988).

[5] This nationalization must be understood as a transfer of ownership from private national bankers to the State. Thus, it must not be confused with usual Latin American nationalizations that involve a transfer of ownership from foreigners to nationals.

The following are some of the main features of the Costa Rican banking system after the nationalization:

(a) The government-owned banking system consists of four banks: Banco Nacional de Costa Rica, Banco de Costa Rica, Banco Anglo-Costarricense, and Banco Credito Agricola de Cartago. Autonomous by law, in practice they became heavily intervened by the Government.

(b) As a result of intense government intervention and the power of the authorities, the prospects for explicit and implicit coordination of the state-owned bank strategies, i.e., tacit collusion, should not be discarded. It is very likely that the Central Bank, as the regulator, became an instrument for the government-owned banks to coordinate their decisions[6].

(c) The nationalized banks were expected to carry out social objectives. They were forced, for example, to finance specific projects and to help preferred sectors, chosen on the basis of social and political rather than economic criteria. The profit-oriented behavior of the nationalized banks was thus heavily constrained[7].

(d) The Central Bank implemented strict controls on the allocation of credit and the setting of interest rates (at subsidized levels in many cases). It is reasonable to hypothesize that the nationalization decree implied collusive tendencies in both the

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[6] This argument of the regulator as a regulatees' agent has been introduced by Stigler (1971).

[7] Some authors are inclined to consider the extreme case. They state that the government-owned banks do not behave as profit maximizers at all. Other authors have a preference to see the government-owned banks as profit maximizers but facing a heavy burden as a consequence of government intervention. This burden could be interpreted as a tax. Several considerations have been made about the existence of other arguments in the objective function of the nationalized banks.

input and the output markets and a behavior of the government-owned banks that contained non-economic considerations. Moreover, lack of competition in the industry may have been a disincentive to pursue economic efficiency more aggressively.

The emergence of a dynamic private banking sector in the 1980s should imply, if the hypotheses above are true, a structural change that goes beyond a simple variation in the concentration index, altering the way in which the nationalized banks behave and their performance in both the input and the output markets. Finally, the nationalization decree did not prohibit the operation or entry of new private banks, but it constrained their sources of funds. Hence, the fact that no private bank entered the industry for several decades, combined with a total modification of the situation in the 1980s, requires an explanation.

3. EVOLUTION OF THE BANKING INDUSTRY STRUCTURE

Table 1 shows the evolution of the market shares of the government-owned banks with respect to total assets and total earning assets of the system. Because these are the four largest banks in the industry, this information can be associated to a C_4 index. Table 1 shows the evolution of the Herfindahl index for both total assets and earning assets as well.

This table shows an almost complete dominance of the banking industry by the government-owned banks until the 1980s. Their market shares were near or above 99 percent. The Herfindahl indices indicate that the industry was highly concentrated during those years. On the other hand, a strong tendency towards deconcentration is evident during the 1980s, the market share of the nationalized banks fell from 99.1 percent in

December 1980 to 69.6 percent in June 1990. The Herfindahl index for earning assets declined from 0.333 to 0.170 during the same period.

TABLE 1
COSTA RICA: MARKET SHARE OF THE GOVERNMENT-OWNED BANKS AND INDUSTRY'S HERFINDAHL INDEX

YEAR	T.A.	E.A.	H-T.A.	T-E.A.
1955	99.1	99.2	0.3595	0.3619
1960	99.6	99.7	0.3320	0.3281
1965	99.7	99.8	0.3375	0.3350
1970	99.4	99.6	0.3310	0.3246
1975	98.9	99.2	0.3216	0.3245
1980	98.9	99.1	0.3354	0.3330
1982	96.8	97.1	0.3115	0.3172
1984	94.6	97.1	0.3115	0.3172
1986	90.2	84.1	0.2651	0.2331
1988	86.7	73.7	0.2446	0.1861
1990	87.3	69.6	0.2531	0.1702

NOTES:
T.A. = Market share of government-owned banks in total assets.
E.A. = Market share of government-owned banks in earning assets.
H-T.A. = Herfindahl index for banking industry's total assets.
H-E.A. = Herfindahl index for banking industry's earning assets.

Preliminary tests using the C_4 index show the presence of structural change in the Costa Rican banking industry. Table 2 contains results from regressions using data for earning assets, in particular from restricted regressions using pooled data for the period from June 1974 to June 1990, and from unrestricted regressions using either December 1978 or December 1982 as the break point[8].

Three different methods were applied. First, ordinary least squares (OLS) was used. Two shortcomings were found: the Durbin-Watson coefficient is very low, showing the

[8] These unrestricted regressions are specified in such a way that continuity is assured at the break point.

presence of autocorrelation, and this method does not guarantee that the dependent variable is between 0 and 1. Second, in order to correct for autocorrelation, an AR(1) specification for the error term was assumed. Third, a logistic specification was fitted in order to correct for the dependent variable's restriction[9].

TABLE 2

COSTA RICA: ECONOMETRIC RESULTS ON CONCENTRATION OF BANKING INDUSTRY

SPECIF.	RRS	N	R**2	DW
1	0.12805	65	0.772	0.042
2	0.00457	65	0.947	0.196
3	0.04935	65	0.912	0.103
4	0.00623	65	0.989	
5	0.00331	65	0.994	
6	20.4300	65	0.886	0.120
7	13.0500	65	0.927	0.188

1: pooled data, (restricted regression) $y = \alpha + \beta$ Quarter $+ \epsilon$
2: unrestricted regression, ensuring continuity at break point, break point = Dec. 1982. $y = \alpha + \beta_1 * Q_1 + \beta_2 * Q_2 + \epsilon$
3: unrestricted regression, ensuring continuity at break point, break point = Dec. 1978
4: pooled data, assuming AR(1) for errors.
5: unrestricted regression, assuming AR(1) for errors, ensures continuity at break point = Dec. 1982.
6: pooled data, logistic specification.
7: unrestricted regression, logistic specification, ensures continuity at break point = Dec. 1982

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[9] The specification of the logistic functions are:
Regression for pooled data:

$$C_t = \frac{1}{1 + \exp(\beta_0 + \beta_1 t)}$$

Regression with break point and continuity at t':

$$C_t = \frac{1}{1 + \exp(\beta_0 + \beta_1 t_1 + \beta_2 t_2)}$$

where:

$t_1 = t$ if $t < t'$
$t_1 = t'$ if $t \geq t'$

$t_2 = 0$ if $t \leq t'$
$t_2 = t - t'$ if $t > t'$

The objective of these regressions was to gain preliminary insights about structural change in the banking industry. Later on, the Markov Chain technique and other methods can be used to test for structural change, by using the market shares of all the firms in the industry. An F-test was applied as a preliminary test for structural change. Table 3 shows that structural change has occurred. Moreover, combined with table 1, it suggests that the change took place towards the beginning of the 1980s.

TABLE 3
F-TEST FOR STRUCTURAL CHANGE OF THE COSTA RICAN BANKING INDUSTRY
PRELIMINARY RESULTS

	TOTAL ASSETS	EARNING ASSETS
OLS1	384.0*	1675.2*
OLS2	160.3*	98.9*
AR(1)1	7.7**	54.5*
LOGIST.1	32.4*	35.1*

NOTE: */ significant at 5%.
**/ significant at 10%.

More than a simple change in the trend of the concentration measures over time, what the Costa Rican banking industry experienced during the 1980s was a total transformation in its structure. The industry underwent a substantial process of entry. Table 4 presents the evolution of the number of banks in the industry[10]. During the 1980s, the number of banks increased from 9 to more than 20; in fact, during this period 16 new banks entered and 4 banks exited the industry. When the examination is limited to the private sector of the industry, it is found that the number of banks increased from 5 in

[10] The definition of an industry's boundaries is always a problem. This proposal restricts the analysis to those entities authorized to use the word "bank" in their names. In addition to the government-owned and private banks, the Costa Rican financial system includes a large number of finance companies and financial cooperative associations, some savings and loans associations, one government-owned insurance company, and other public sector financial institutions.

December, 1980 to 17 in June, 1990, for an increase of almost 250 percent. It is also important to recognize the vital role played by the grow of some of the new banks in the industry's transformation. Actually, the majority of the new banks entered in very small sizes; however, some of them have shown notable rates of growth in their market shares.

TABLE 4
COSTA RICA: EVOLUTION OF THE NUMBER OF BANKS. ENTRY AND EXIT RATES

DEC/YEAR	# BANKS	# NAT.B.	# PRIV.B.	ENTRIES	EXITS
1976	8	4	4		
1978	9	4	5	1	0
1980	9	4	5	1	1
1982	14	4	9	5	0
1984	17	4	13	3	0
1986	21	4	17	4	0
1988	23	4	19	4	2
1990*	21	4	17	0	2

NOTE: */ corresponds to June, 1990.

In summary, this first examination of the data generates the following facts and hypotheses:

(a) In the Costa Rican banking industry some private banks are expanding by taking over the market shares of the large, dominant, government-owned banks, whose market shares are changing as well.

(b) Competition among banks can not be merely characterized as competition between private and government-owned banks. In fact, depending on the period considered, it is possible to detect situations where private banks compete with private banks, nationalized banks compete with nationalized banks, and private banks compete with nationalized banks.

(c) The intensity of these different ways of competition has not remained constant over time. Thus, in this case competition refers more to a process than to a situation.

(d) Not all the incumbent banks are behaving in the same way; it is conceivable to have some degree of heterogeneity in the strategies (conduct) followed by the firms.

(e) There has been an accompanying process of birth and death of firms.

(f) The conditions for some degree of collusion among the government-owned banks existed before the 1980s. It would be interesting to observe what happened with this collusive tendencies during and after the structural change. In other words, one would like to know how the cartel reacted.

In conclusion, the issue is the evolution of an industry, where structural change has occurred and which is in a process of continuous transformation. To understand the evolution of this industry, a dynamic approach is needed. It is also important to study the relationship between this structural transformation of the industry and some performance and conduct measures. The majority of the research on the relationship between structure and performance uses cross-industry studies and, in consequence, the emphasis placed on the idiosyncratic characteristics of the industry is minor. The presence of structural change in the Costa Rican banking industry allows for an study of the (inter)relationship between structure and performance, where conduct and idiosyncratic attributes of the industry play an important role.

4. MARKOV PROCESSES AND THE STUDY OF THE EVOLUTION OF INDUSTRY STRUCTURES

> *"Uncertainty, complexity, and dynamism have been continuing challenges to man's understanding and control of his physical environment. In the development of logical structures to describe these phenomena, the model*

originated by A. A. Markov stands as a major accomplishment. Where previous contributors had modeled uncertainty as a sequence of independent trials, Markov saw the advantage of introducing dependence of each trial on the result of its predecessor. While it is tempting to consider even more complex dependency of the present trial on the results of past trials, such temptation usually leads to results that are both analytically and computationally intractable. ... Consequently, Markov models represent the first outpost in the domain of dependent models that is powerful both in capturing the essence of many dependent systems observed in practice and in producing the analytical and computational results necessary to gain insight into their behavior."[11]

Markov stochastic processes have been extensively used in the literature to analyze dynamic processes in several economic areas (e.g., Steindl, 1965; Chiappori,1984; Newman and Wolfe, 1961; Padberg, 1962; Mellor, 1984; Hallberg, 1969; Atkin and Blandford, 1982; Raj et al 1979; Mellor and Hessner, 1986)[12].

4.1 MARKOV CHAINS

A Markov chain can be associated with a sequence of trials where the probability of the outcome of each individual trial depends on the outcome of the immediately preceding trial, but not on the other prior outcomes. If the set of potential outcomes is finite, then the stochastic process is called a first-order Markov chain.

Given a constant transition probability, the outcome in trial t depends only on the outcome in trial t-1. Since the outcome in trial t-1 depends on the outcome in trial t-2, and so on, by applying a recursive method it is possible to relate the outcome in trial t to any

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[11] Howard, 1971, page ix.

[12] For an introduction to Markov Processes see Howard (1971); Hoel, Port, and Stone (1972); Iosifescu (1980); and Thie (1983).

past outcome, e.g. in trial t-n. Therefore, it is possible to characterize the whole outcome-path (trajectory) in terms of an initial outcome in trial t-n and the transition probability.

A first-order stationary Markov process is characterized by the following statement of conditional probability:

$$Pr(X_t = S_j) = \sum_I [Pr(X_{t-1}=S_i)]\ [Pr(X_t=S_j) / (X_{t-1}=S_i)] \qquad (1)$$

This statement indicates that the probability for variable X to be in state S_j in trial t is conditional on the state where this variable was in trial t-1, and on the probability of moving from the state where it was in t-1 to the state S_j in trial t. It is assumed to be independent of the trial itself.

Then, for a finite vector of n states: $S_1, S_2, \ldots, S_n$, it is possible to define a matrix of transition probabilities P, whose elements P_{ij} show the probability of being in state S_j in trial t having been in state S_i in trial t-1. This matrix is called the **transition probabilities matrix** or stochastic matrix. It can be represented as:

$$P = \begin{vmatrix} P_{11} & P_{12} & P_{13} & \cdot & \cdot & \cdot & \cdot \\ P_{21} & P_{22} & P_{23} & \cdot & \cdot & \cdot & \cdot \\ \cdot & & & & & & \\ \cdot & & & & & & \\ \cdot & & & & & & \\ \cdot & & & & & & \\ P_{n1} & P_{n2} & \cdot & \cdot & \cdot & \cdot & P_{nn} \end{vmatrix} \qquad (2)$$

The nature of the process implies that the rows of the matrix must satisfy the following two conditions:

$$\sum_{j} P_{ij} = 1 \qquad (3)$$

$$0 \leq P_{ij} \leq 1 \qquad (4)$$

4.2. MARKOV CHAINS AND THE SIZE DISTRIBUTION OF FIRMS

Stochastic Markov processes have been applied to the study of the evolution of the size distribution of firms (e.g., Adelman, 1958; Horowitz and Horowitz, 1968; Hart and Prais, 1956). In these studies, many size categories are defined, and the industry's firms are classified according to size. These size categories play the same role as the states in trial analysis.

When a Markov chain process is used to study the evolution of the size distribution of firms, the transition probabilities P_{ij} depict the likelihood, for a firm, of being in size category j at time t after having been in size category i at time t-1. Given an original size distribution of firms and the matrix of transition probabilities, it is possible to describe a **time path** or trajectory for the evolution of the distribution of firm sizes. Furthermore, if one assumes that the transition probabilities matrix does not change in the future[13], then it is possible to find at least one **immovable point** defining the limiting state probability of the process[14]. This immovable point may be associated to a **long-run equilibrium** or **steady-state** concept for the size distribution of firms.

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[13] This is an assumption similar to the *ceteris paribus* assumption that economists use when predicting the future behavior of a variable.

[14] See Howard, 1971, page 33.

Mathematically, given an initial size distribution of firms at time t, shown by the vector

$$S_{jt} = (S_1 t,\ S_2 t,\ S_3 t,\ \ldots,\ S_{nt}) \qquad (5)$$

where S_{jt} represents the proportion of firms in size class j at time t, and given the transition probabilities matrix [P], the next size distribution configuration can be calculated in the following way:

$$(S_j(t+1)) = (S_j t) \times [P] \qquad (6)$$

Applying successive substitutions one may end up with an immovable point $E_{j,t+k}$ that satisfies the following equation:

$$(E_j(t+1)) \times [P] = (E_j t) \qquad (7)$$

Therefore, one can claim that, if there is no change in the transition probabilities matrix, $E_{j,t+k}$ defines the equilibrium situation of the process that explains the size distribution of firms, where

$$(E_j(t+k)) = (E_1(t+k),\ E_2(t+k),\ E_3(t+k),\ \ldots,\ E_n(t+k)) \qquad (8)$$

It is important to notice that this is in fact a **dynamic equilibrium** for the firms and a **static equilibrium** for the industry as a whole. In other words, in the equilibrium situation firms are in an incessant competition to improve their size ranking. Some firms could be moving upward and other firms could be moving downward, but, as a whole, their movement implies an industry's structure that is stable with respect to the proportion of firms in each size category.

4.3. MARKOV CHAINS AND THE EVOLUTION OF THE FIRM'S MARKET SHARE

Markov processes have been used to study the evolution of an industry's structure through the analysis of market shares as well (e.g., Raj, Kirkham and Clarke, 1979; Daskin, 1985; Mellor and Hessner, 1986; Mellor, 1984; Atkin and Blandford, 1982). In this case, a first-order stochastic Markov model can be specified in the following way:

$$M_j(t) = \sum_i M_i(t-1)\, P_{ij} \qquad (i, j = 1, 2, \ldots\ldots, n) \tag{9}$$

where $M_j(t)$ and $M_j(t-1)$ are the observed market shares of firm j at time t and t-1 respectively, and the P_{ij} are the transition probabilities. With respect to market shares in the output market, the transition parameter P_{ij} must be interpreted as the probability that a customer (or group of customers) will become a client of firm j after having been a client of firm i in the previous period[15].

The intuition behind the use of a first-order Markov stochastic process to explain the evolution of market shares is that at every period of time the firms are taking strategic actions to compete for customers in the market. These actions may succeed or fail to increase market shares, and their possible realization is represented by a density function. Thus, at the beginning of the period there is a density function associated with the probability of achieving different market shares at the end of the period. This density function is conditional on the firm's market share at the beginning of the period. In consequence, the initial position of the firm (market share at t) and the actions taken by the

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[15] A more accurate meaning for the term "customer" could be "$1-customer".

firm during the period, determine the firm's position at the end of the period (market share at t+1).

Furthermore, because there are many firms in the industry, the market share realizations at the end of the period are interrelated. This is, the realization of the market share at t+1 for firm i depends on its current position at t, the actions taken by firm i, and the actions taken by the other firms in the industry during the period in consideration. The use of a Markov chain takes into account this interrelation of market share realizations.

4.4 ESTIMATION OF THE TRANSITION PROBABILITIES

The problem faced is that the transition parameters are unknown and must be estimated. If one could keep track of all the customers in the system, then it would be easier to estimate the transition probabilities, but the information available generally refers to aggregate data such as the total firm's output or market shares.

Fortunately, Lee, Judge, and Zellner (1970), and previously Telser (1963), showed that it is possible to estimate the transition probabilities from aggregate data, by using least-squares techniques. Further developments have suggested different ways to estimate the transition parameters. The estimations suggested differ on the specification of the transition probabilities and on the techniques to be used. Constant and time-varying transition probabilities are among the specifications suggested. OLS, restricted LS, and Non-linear least squares are among the techniques employed.

(a) Constant Transition Probabilities estimated with Ordinary Least Squares Techniques:

Given a sample data of market shares collected for n firms and T periods, then in order to estimate the transition probabilities, the stochastic Markov process may be written in matrix form as:

$$M_j = \Lambda_j \; P_j + \mu_j \qquad E(\mu_j) = 0 , \tag{10}$$

where

$$M_j = \begin{vmatrix} M_{j1} \\ M_{j2} \\ . \\ . \\ . \\ M_{jT} \end{vmatrix} , \quad P_j = \begin{vmatrix} P_1 j \\ P_2 j \\ . \\ . \\ P_{nj} \end{vmatrix} , \quad \mu_j = \begin{vmatrix} \mu_{j1} \\ \mu_{j2} \\ . \\ . \\ . \\ \mu_{jT} \end{vmatrix} \tag{11}$$

$$(j = 1, 2, 3, \ldots, n)$$

and Λ_j is the following (T x n) matrix:

$$\Lambda_j = \begin{vmatrix} M_1(1) & M_2(1) & M_3(1) & \ldots & M_n(1) \\ M_1(2) & M_2(2) & . & \ldots & M_n(2) \\ . & & & & \\ . & & & & \\ . & & & & \\ . & & & & \\ M_1(T-1) & M_2(T-1) & . & \ldots & M_n(T-1) \end{vmatrix} \tag{12}$$

Then, the time-series data set of market shares can be used to estimate the unknown parameters P_{ij} by using **ordinary least squares (OLS)** in the following equations:

$$M_j(t) = \sum_{i=1}^{n} M_i(t-1)\, P_{ij} + \mu_j \qquad (i, j = 1, 2, \ldots, n)\ (t = 2, 3, \ldots, T) \qquad (13)$$

where the disturbance terms $\mu_j(t)$ are assumed to have zero mean, and to be serially uncorrelated. Because there are n firms in the sample, the estimated parameters form the (n*n) estimated transition probabilities matrix.

(b) Constant Transition Probabilities estimated with Restricted Least Squares:

Sometimes the ordinary least square estimates do not satisfy the restrictions mentioned in equations (3) and (4), in these cases it becomes necessary to apply **restricted OLS** to equations (13)[16].

(c) Varying Transition Probabilities estimated with restricted least squares:

In this case a linear dependency between the transition probabilities and an exogenous explanatory variable is assumed[17]:

$$P_{ij}(X_t) = \alpha_{ij} + \beta_{ij} X_t \qquad (14)$$

Notice that because X is a time series variable, or even time itself, then the transition probabilities become time-dependent, and there will be a transition probabilities matrix for every period. In consequence, X defines the time path of the transition probabilities and, indirectly, the time path of the industry's structure.

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[16] See Lee, Judge and Zellner, 1970.

[17] In fact, X may be a vector of exogenous variables. In this case β becomes also a vector of parameters. For simplicity, the expression assumes that the transition probabilities at t are related to the current values of the exogenous variable X, in fact it is possible to argue that the transition probabilities at t are related to past values of X.

The estimation of the transition probabilities requires the application of restricted OLS to the following equations:

$$M_{ij}(t) = \sum_{i=1}^{n} (\alpha_{ij} + \beta_{ij} X_t) M_i(t-1) + \mu_j \quad (i, j = 1, 2, 3, \ldots, n) \quad (t = 2, 3, \ldots, T) \tag{15}$$

Notice that this technique estimates the parameters α_{ij} and β_{ij}; from them it is possible to calculate the transition probabilities[18].

(d) Varying Transition Probabilities with Multinomial Logit Formulation and estimated with non-linear least squares:

MacRae (1977) develops an econometric technique to estimate time-varying transition probabilities in a first-order Markov process. It assumes that the transition probabilities depend on an exogenous explanatory variable that, in consequence, defines the time-path of the transition probabilities and, indirectly, of the industry's structure. This technique uses a multinomial logit formulation of the transition probabilities in order to satisfy the parameter constraints[19].

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[18] Mellor and Hessner (1986) use a very interesting varying transition probabilities technique based on time-dependent dummy variables. They specify the transition probabilities in the following way:

$$P_{ij} = \alpha_{0ij} + \alpha_{1ij} D(t) + \alpha_{2ij} \Delta(t)$$

where D(t) is a dummy-type explanatory variable that depends on time, and $\Delta(t)$ is a conventional binary variable to account for seasonality. With this technique it is possible to study the impact of external shocks and events such as regulatory reforms, macroeconomic shocks, and the like. Furthermore, one can model shocks whose effect is presumed to persist over time.

This technique may also be useful to analyze the repercussions of regulations (**intervention analysis**), innovations, and any other external shock that can not be completely embraced by the firms at the moment of their introduction. Mellor and Hessner's technique can also be used to study seasonal effects. Obviously, the quantity of dummy and other explanatory variables that can be included in the analysis is severely constrained by the size of the sample.

[19] This technique was suggested first by Theil, 1969.

MacRae assumes that each individual transition probability varies over time in response to exogenous variables. Thus, the following equation describes the functional form of the individual transition probabilities:

$$P_{ij}(t) = f_{ij}\,(z(t-1),\ \beta_{ij}) \qquad (16)$$

where **z(t-1)** is a vector of lagged exogenous or predetermined variables and β_{ij} is a vector of parameters relating the exogenous variables to the transition probabilities. Because the functional form f_{ij} must be such that the transition probabilities satisfy the nonnegativity and sum-to-unity-by-rows conditions, then a specific formulation for f_{ij} must be assumed. MacRae proposes the following multinomial logit formulation for the functional form[20]

$$F_{ij}\,(z(t-1),\ \beta_{ij}) = F_{ij} = \ln\,(P_{ij}(t) / P_{in}(t)) \quad \begin{matrix}(i = 1, 2, \ldots xn) \\ (j = 1, 2, \ldots, n-1)\end{matrix} \qquad (17)$$

which for convenience uses the last column of the transition probabilities matrix as denominator[21]. Equation (17) guarantees that the parameters F_{ij}, that relate the space of the exogenous variables to the space of the transition probabilities, are nonnegative. From equation (17) one gets:

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[20] This functional form is called F_{ij} to differentiate it from the general formulation f_{ij}.

[21] For simplicity, the relationship between z(t-1) and F_{ij} may be assumed to be linear. For example, if there is just one exogenous variable z(t-1), then the specification for F_{ij} becomes:

$$F_{ij} = \beta_{0ij} + \beta_{1ij}\, z(t-1)$$

Furthermore, if no exogenous variable is introduced, this technique makes it posssible to estimate constant transition probabilities.

$$P_{ij}(t)/P_{in}(t) = \exp(F_{ij})$$
$$\rightarrow P_{ij}(t) = \exp(F_{ij})\ P_{in}(t) \qquad (18)$$

The sum-to-unity-by-rows condition implies that

$$\sum_{j=1}^{n-1} P_{ij}(t) = P_{in}(t) \sum_{j=1}^{n-1} \exp F_{ij}(t) \equiv 1 - P_{in}(t) \qquad (19)$$

Therefore, it is possible to specify the individual transition probabilities in the following way:

$$P_{in} = 1 / (1 + \sum_{j=1}^{n-1} \exp F_{ij}(t)$$
$$and \qquad (20)$$
$$P_{ij}(t) = \exp F_{ij}(t) / [1 + \sum_{j}^{n-1} \exp F_{ij}(t)]$$
$$for \quad (j = 1, \ldots\ldots, n-1)$$

These transition probabilities have the advantage of allowing for variation over time and satisfying the nonnegativity and sum-to-unity-by-rows conditions. The estimation of the transition probabilities requires an estimate first of the β parameters, by applying non-linear least squares to the following set of equations[22]:

$$M_j(t) = \sum_{i=1}^{n} P_{ij}(t)\ M_i(t-1) + \mu_j(t)$$
$$(j = 1, 2, \ldots, n-1)$$

The last column of the transition probabilities matrix can be obtained by residual, by applying the sum to unity by rows condition.

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[22] Because the variance of the residuals $\mu_j(t)$ depends upon the lagged market shares ($M_i(t-1)$), the nonlinear estimates are consistent but not efficient. MacRae suggests an iterative GLS procedure to get more efficient estimates.

5. CLUSTER ANALYSIS AND THE USE OF PANEL DATA

A vast literature deals with the existence of an structure within the industry. This literature assumes that the firms in an industry may follow different strategies and that, once they have chosen a particular strategy, it may be difficult for them to switch to other strategies in the short run. A non-structuralist approach, where the conduct of the firms plays a very important role in the determination of both their performance and the structure of the industry is appealing. This proposal is specially concerned with the relationship between the firms' conduct and the evolution of the industry's structure.

According to the Evolutionary Theory, the Markov process assumption is justified because the firms in the industry are exploring new strategies. If these strategies are successful, then the firms may enjoy a period of relative growth (market share expansion); if the strategies are not successful, this will be reflected in a period of market share contraction. The length of this period depends on the ability of the firms applying unsuccessful strategies to revert them and to either imitate the successful firms or to innovate with a better strategy[23].

Furthermore, external shocks and events, such as an expansion of the fiscal deficit or a change in the relative prices of inputs, may transform the industry's structure, because the firms are not following similar strategies, and consequently they will not be equally affected. Therefore, it is crucial to test for the existence of strategic groups in the industry and to have an idea of the degree of strategic mobility barriers.

In a contribution to the empirical literature of group structures, Oster (1982) develops exploratory tests to examine intergroup mobility in an industry. She uses a single strategic

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[23] It is also possible for the successful firms to successfully innovate in order to keep their relative advantage. These issues are clearly related to the degree of strategic mobility in the industry.

variable as the relevant criterium to define the strategic groups, and then develops a mobility index based on the ratio of the number of group changes during a given period over the number of potential group changes during the period[24]. Although the work of Oster focusses on comparing the mobility index among industries, it may be useful to study its evolution over time. The evolution of this mobility index may be a good indicator of the long run trend in strategic mobility barriers and strategic imitation. It must be stated that Oster's procedure to group firms is very rudimentary.

A more rigorous methodology to group firms and to test the validity of the homogeneity assumption is followed by Hatten and Schendel (1977)[25]. Their work consists of the use of panel data to test the null hypothesis of homogeneous conduct within the industry[26]. Thus it is important to study in detail Hatten and Schendel's methodology and to explain its usefulness. This clustering technique identifies the relationship that exists between a performance variable and a vector of strategic managed variables and exogenous structural variables for every firm. If the relationship is similar for two firms, one can argue for placing them in the same strategic group, because they show the same link between strategy and performance.

Start with a panel data of the following observations:

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[24] Oster works with the advertising to sales ratio.

[25] One of the more serious criticisms that Hatten and Schendel make to the cross-sectional studies is the implicit assumption, without testing it, of strategic homogeneity within the industry.

[26] The methodology followed by Hatten and Schendel makes it possible to cluster the individual firms into strategic groups, to have a preliminary measure of the degree of heterogeneity within the industry (degree of industry fragmentation), to study how disparate groups are differently affected by changes in their managed strategic variables and in external variables, to test for structural break in the strategic behavior of the firms, and to analyze how the relative effectiveness of various managed variables changes over time.

$$Y_{it},\ X_{i1t},\ X_{i2t},\ \ldots\ X_{imt} \quad (i = 1, \ldots, n) \quad (t = 1, \ldots, T) \tag{22}$$

where the index i refers to firms, the index t refers to the observation period, the variable Y_i refers to a measure of performance of firm i, and the variables X_{ij} (j=1,2,...,m) refer to strategic indicators and structural variables, these later variables may be current or lagged variables.

Therefore, the model can be expressed as:

$$Y_i = f(X_{ij}) \quad (i=1,2,\ldots,n) \quad (j=1,2,\ldots,m) \tag{23}$$

If one assumes a linear relationship between the vector of regressors and the regressand, and adds a disturbance term, the expression becomes:

$$Y_i = \beta_{io} + \beta_{i1} X_{i1} + \beta_{i2} X_{i2} + \ldots. + \beta_{im} X_{im} + \mu_i \quad (i=1,2,\ldots,n) \tag{24}$$

Then, the **first step** to group firms consists in using OLS or GLS to estimate the unknown coefficients (β parameters) of the equation above. The **second step** involves the application of Chow tests for the null hypothesis: that the estimates for some firms are similar. Thus, this step requires to pool the data for all possible pairs of firms and to estimate the β parameters using the pooled data for each pair of firms[27]. Therefore, this second step clusters firms into groups of two.

The grouping of firms into clusters faces two problems that are related to the determination of the appropriate order of pooling. First, what criteria to follow when the Chow

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[27] Johnston, 1984, has a good exposition of the different techniques that can be used to pool time-series and cross-section data. An excellent exposition of the longitudinal analysis techniques is made by Hsiao (1989).

test accepts the null hypothesis for various groups containing the same firm. Second, what criteria to use to cluster new firms to the initial groups. Hatten and Schendel apply the methodology suggested by Johnson (1967) in his paper on the hierarchical cluster scheme. Johnson's methodology consists in the calculation of the ratio of the F-statistic to the critical F-value at the 95 percent level for the degrees of freedom involved for every potential pair of pooled firms. Then the F/F_c value is used as an unidimensional measure of the distance between firms or groups. The lower the value of this F/F_c, the closer the firms or groups are with respect to their strategic position.

Hence, the **third step** involves the calculation of the F/F_c values for all the potential groups, obtaining a matrix of F/F_c values that can be used to cluster firms by looking at their degree of strategic closeness. This technique can be used further to merge new pairs of groups. The smallest F/F_c is joined first. A value of F/F_c larger than 1 may be a good criterium to use to stop clustering firms, because it means that the null hypothesis is rejected[28].

Thus, following this clustering methodology one ends up with a segmentation of the industry into several strategic groups. This different look at the industry, which stresses the role of conduct, can be used to study how the different groups react and are affected by external shocks. It also permits to study the relationship between the firms' group membership and their performance in what respect to expanding their market shares. Furthermore, if the data shows some heterogeneity across time it may be possible to identify a break point and split the data for each time period. This time heterogeneity of the data can be used to study changes in the

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[28] It is important to state that Hatten and Schendel recommend to avoid a totally mechanical application of the grouping procedure, and to combine the statistical technique with some selective pragmatism during the exploratory stages.

strategic distance between firms, to examine if there exists any change in the groups configuration, and to observe if there has been any change in the relative effectiveness of some strategic managed variables between the two time periods.

6. LIST OF HYPOTHESES OF THE INVESTIGATION

This section summarizes the main hypotheses of the proposed research and further comments on the methodology to test these hypotheses.

6.1 STRUCTURAL CHANGE

Structural change took place in the Costa Rican banking industry. Preliminary tests for structural change used concentration indices. An F-test, that takes into account the whole industry, instead of a concentration index, could be used to test for structural change[29]. Raj et al (1979) suggest this procedure.

6.2 COLUSION AND COMPETITION

The nationalized banks were practically alone before the 1980s. There were clear opportunities for them to coordinate their decisions. The project hypothesizes that some kind of monopsonistic and monopolistic behavior (collusion) existed in the Costa Rican banking industry before the 1980s. Additionally, once the number, size, and aggressiveness of private banks increased, and the market share for the nationalized banks shrunk, one should expect a less

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[29] Several exploratory methodologies exist to identify the moment when the structural break took place, for example, a CUSUM technique could be applied using a concentration index.

stable cartel, and in consequence the appearance of more rivalry among the nationalized banks[30].

The hypothesis is that the emergence of private banks forced the nationalized banks to react by fighting against each other, playing more aggressively, and competing strongly for what is left of their market share (in either the output or input markets). The transition from a period of collusion to a period of more intensive competition should be reflected in a decrease over time in the diagonal elements of the matrix (loyalty indicators) and an increase over time in some of the off-diagonal elements of the transition probabilities matrix[31].

The methodology to be used to test this hypothesis consists in the specification of time-varying transition probabilities. For simplicity of exposition, a linear dependency between the transition probabilities and time will be assumed. With a multinomial logit formulation, the specification of the transition probabilities and of the tests becomes more complicated. The intuition behind the tests is, however, the same[32]. For this purpose, the transition probabilities can be specified in the following way[33]:

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[30] An initial exploration of this hypothesis was made by comparing quarter to quarter variability of market shares of the nationalized banks before and after 1980. In all the cases there was a significant increase in the variability of market shares. It must be stated that I am using the quarter to quarter stability of market shares as a proxy for the degree of competition. Very stable market shares are associated with the existence of collusion, while very unstable market shares are associated with the existence of competition.

[31] Notice that I am using the values of the transition probabilities as proxies for the degree of (dynamic) rivalry in the industry.

[32] It must be stated that the use of a multinomial logit formulation allows for additional analysis and considerations such as the rate at which the transition probabilities change over time.

[33] If a multinomial logit formulation is used then the specification becomes:

$$F_{ij} = \beta_{0ij} + \beta_{1ij}\, time$$

$$P_{ij} = \beta_{0ij} + \beta_{1ij}\, time \qquad (25)$$

In this case, the coefficient β_{1ij} (estimated with data from the whole period from June 1974 to June 1990) is an indicator of the long-run trend in the intensity of competition, and its sign is very important to evaluate whether loyalty (a proxy for collusion) and/or rivalry has changed over time in the nationalized sector of the banking industry.

The null hypothesis is Ho: $\beta_{1ij} = 0$. It means that there is no increase in the degree of rivalry among the nationalized banks during the period in consideration. The alternative hypothesis is H1: $\beta_{1ii} < 0$ and $\beta_{1ij} > 0$, for some of the i's and j's, and it means that competition has increased among some of the nationalized banks[34]. It must be stated that there exist other methodologies to test these hypotheses; for example, introducing a dummy variable in the specification of the transition probabilities[35].

The main advantage of using techniques based on the estimation of transition probabilities matrices is that it is possible to identify the source of rivalry;, thats is, from which rivals an specific bank is gaining or loosing customers. Therefore, one can identify areas (groups of firms) inside the nationalized sector of the banking industry where rivalry is increasing and areas where it is not increasing.

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[34] I am not considering the other possibility: $\beta_{ii} > 0$ and $\beta_{ij} < 0$, which means that a decrease in the degree of rivalry among nationalized banks has taken place.

[35] In this case it is necessary to identify a pre-structural break and a post-structural break subperiod, then a transition probabilities matrix for the whole period must be estimated introducing a dummy variable to distinguish between the two subperiods. So,

$D_j = 0$ if $t <= t^*$, (t^* refers to the structural break point)

$D_j = 1$ otherwise

The null hypothesis is true if $\beta_{1ii} < 0$ and $\beta_{2ij} > 0$.

6.3 RIVALRY

The same methodology used for 6.2 could be used to identify the characteristics of rivalry in a sector of the private banks. For example, one could define a sector of the banking industry containing some of the largest private banks, e.g., Banco de San José, Banco del Comercio, Banco Banex, Banco Cooperativo, Banco Interfin, Banco BCT, and Banco de Fomento Agrícola. Then, it is possible to use market share observations for these banks (market shares are redefined for the sector) for a period such as September 1984 to June 1990 (24 observations) to estimate the transition probabilities parameters[36]. The choice of the private banks must take into consideration that the number of observations is very limited.

This technique makes it possible to identify the areas in the sector where a very intense competition is taking place. Several hypotheses are possible. For example, one could hypothesize that there is no strong competition among the private banks in the sector. Thus, the diagonal elements of the Transition Probabilities Matrix should be very large, while the off-diagonal elements should be very small (close to 0), at least for some banks. One could also hypothesize that the degree of rivalry among these large private banks is increasing over time, because it is becoming more difficult to increase market share through competition with the nationalized banks. Therefore, time-varying transition probabilities could be specified and a test similar to that mentioned in 6.2 could be applied.

6.4 PUBLIC VERSUS PRIVATE BANKS

The methodology in 6.2 and 6.3 could be used to study the characteristics of rivalry in a sector of the banking industry that contains the four nationalized banks and some private

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[36] The definition of the period of analysis takes faces a trade off, it must not be so large that some large private banks can not be included, it must not be so short that the number of observations becomes very small.

banks. Again, it is important to be parsimonious with the number of banks included, because the number of observations available is very limited. For example, one could consider the four nationalized banks and the seven private banks mentioned in 6.3 as a sector of the industry, in order to estimate the transition probabilities matrix[37].

The methodology requires in this case to check which transition probabilities are significantly different from 0, allowing for the identification of the areas where a very intense competition is taking place. The main hypothesis is that the private banks are gaining market share at the cost of the nationalized banks. This can be easily tested by checking the values of the transition probabilities.

6.5 DETERMINANTS OF MARKET STRUCTURE

It is possible to use the transition probabilities technique to test the kind of relationship that exists between some exogenous variables and the evolution of the Costa Rican banking industry's structure. Once more, the constraints in the number of observations available demand moderation in the number of exogenous variables to be introduced in the estimation.

A first variable to be considered is the fiscal deficit[38]. The hypothesis is that the size of the fiscal deficit affects the cost and availability of funds in the securities market (and in the funds market as a whole). Therefore, as a consequence of the asymmetric regulation applied with respect to banking inputs (deposits), where private banks do not have access to demand deposits, it is hypothesized that the market share of some private banks is negatively correlated

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[37] This methodology could be broadened to consider the whole banking industry in the following way: one could include the four nationalized banks, a few large private banks, and then pool the residual private banks into a single firm called others. Notice that this residual firm contains the entry effects, therefore, the interpretation of the corresponding transition probabilities must take into consideration the entry process.

[38] The fiscal deficit must be considered in real terms, or in reference to the size of the economy.

to the fiscal deficit, while the market share of the nationalized banks is positively correlated to the size of the fiscal deficit[39].

The hypothesis is that the fiscal deficit represents a heavier burden for the private banks (PB) than for the nationalized banks (NB)[40]. Hence, a reduction in the fiscal deficit would benefit more the former than the later. Instead of the fiscal deficit, one may use the average interest rate in the securities market. This would be a measure of the cost of funds in this market, but not necessarily of the availability of funds in the whole funds market. To test this hypothesis one must estimate the coefficients β_{0ij} and β_{1ij} of the varying transition probabilities, then:

(a) if i $\in$ NB, and j $\in$ PB, the null hypothesis is Ho: $\beta_{1ij} > 0$, meaning that NB i increases market share at a cost to PB j's market share when the fiscal deficit increases.

(b) if i $\in$ PB, and j $\in$ NB, the null hypothesis is Ho: $\beta_{1ij} < 0$, meaning that PB i looses market share at the benefit to NB j's market share when the fiscal deficit increases.

A second variable to be considered could be the expansion of the securities market, or the expansion of real M2, as a proxy for the degree of financial deepening[41]. The hypothesis is that the market share of PB is positively correlated to the degree of financial deepening, while

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[39] Notice that it could be possible to test this hypothesis by running a simple regression between the market share of each bank and the fiscal deficit. However, the result of this regression does not tell us the source of the change in the market share of the bank.

[40] In other words, a large fiscal deficit is a more serious disadvantage for PB than for NB because it increases the cost and crowds out the PB's unique source of funds, while the NB also have access to the demand deposits (which may also be affected by the fiscal deficit depending on the elasticity of substitution). Notice that this effect happens in the input market, however, its consequences should be reflected in the output market.

[41] In fact these are proxies of the capacity of PB to circumvent the asymmetric regulation they are facing in the input market. Thus, they are associated with a process of regulatory avoidance.

the market share of NB is negatively correlated. The same kind of test could be applied to any other exogenous variable presumed to influence the evolution of the Costa Rican banking industry's structure.

6.6 EXOGENOUS SHOCKS

The estimation of a transition probabilities matrix for the banking industry may also take into account the existence of exogenous shocks caused by factors such as financial crises (i.e. 1987-1988), changes in asymmetric regulation, and introduction of important innovations. The estimation methodology requires a consideration of varying transition probabilities, such a those in 6.5. But, instead of an exogenous variable, one must introduce a dummy-type variable in the specification of the transition probabilities[42].

6.7 FORECASTING

Once the transition probabilities have been estimated, it is possible to forecast the evolution of the Costa Rican banking industry's structure. Moreover, concentration indices may be calculated and predicted. Two factors must be examined when forecasting the time path of the evolution of the industry's structure; first, the long-run equilibrium situation (the immovable point), which must be calculated; second, the speed at which the industry's structure moves towards the long-run equilibrium, which may be estimated.

Two hypotheses are generated from this analysis. The first hypothesis states that the market share of the private banks will increase while the market share of the nationalized banks will decline in the long run. It is interesting to have an idea about the sizes that these sectors

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[42] Following the time-series literature, the dummy variable could be specified in several forms to take into account the different kinds of shocks or interventions that may occur. For example, one could specify a step function for the shock, or a one shot or pulse shock; and their effects could vanish slowly or immediately.

will reach in the long run. The second hypothesis is more intricate, dealing with the speed at which the change of the industry's structure will occur in the future. Different factors are intervening in the determination of the speed. On the one hand, a learning by doing process in the private banks and an improvement in the regulatory avoidance process tend to increase the speed. On the other hand, the reaction of the nationalized banks in recent years and their more aggressive behavior tend to reduce this speed.

6.8 COMPETITION AMONG PUBLIC BANKS

Concerning the behavior of the four nationalized banks, one may hypothesize that these banks were located in the same strategic position before the structural break. This assumes that the nationalized banks had accommodated to a comfortable position, where strategic innovation was scarce and where they were following the same conduct. With the emergence of the private banks, the government-owned banks were forced to react and to find new ways to compete strategically. Therefore, it is possible to hypothesize that, as a consequence of the nationalized banks' reaction, a dispersion in their strategic behavior has taken place. Thus, the nationalized banks can no longer be placed in the same cluster.

Once the two periods for consideration have been chosen (e.g., from 1974 to 1980 and from 1984 to 1990); the following hypothesis can be tested by using clustering techniques:

Ho: the four nationalized banks are in the same strategic cluster in the first period, but not in the second period. In the second period some banks have separated from the others, in the sense that they no longer can be clustered together[43].

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[43] A second way of testing the same hypothesis is to check whether the unidimensional measure of strategic distance between firms or groups (F/F_c) has increased between the two periods.

A variant of this hypothesis is that the nationalized banks reacted to the emergence of the private banks by changing their strategies (strategic position)[44]. This hypothesis could be tested by applying the clustering technique to every nationalized bank for the two periods mentioned above. In other words, one must consider a bank in 1974-1980 and the same bank in 1984-1990 as two different banks. The test requires to check whether they could be clustered or not. The null hypothesis Ho implies that a cluster is rejected.

A clustering technique could also be used to test whether the nationalized banks and the private banks are located in different strategic positions. Thus, clustering analysis could be applied to the four nationalized banks and some private banks for which enough observations are available. The main hypothesis involves whether the banks are strategically homogeneous or not. This is:

Ho: Banks are homogeneous. All banks in the same cluster.

H1: Banks are heterogeneous. Several clusters will be formed.

A second hypothesis refers to whether the fast-growing private banks can be placed in the same cluster, implying that they are strategically closer, and the slow-growing private banks can be placed in a different cluster. This hypothesis attempts to test whether some private banks are growing more rapidly than others because they are located in a different strategic group or just because they are manipulating the strategic variables in a different way.

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[44] It is important to clarify this concept of strategic clustering. To have two banks in the same strategic cluster does not mean that they are managing the strategic variables (i.e. financial ratios) in the same way, but that the relationship between the strategic variables and some performance variables is the same for both banks, and that in consequence if the two banks handle the strategic variables in the same way they will get the same results. If the two banks are in different clusters then even if they handle the strategic variables in the same way they will not get the same results.

Ho: Fast growing banks are homogeneous (all in same cluster). Slow growing banks are homogeneous (all in same cluster). Fast growing and slow growing banks are heterogeneous (not in same cluster).

7. THE STATISTICAL INFORMATION REQUIRED AND ITS SOURCES

The techniques to test these hypotheses require the following data:

First, data for earning assets and total assets can be used as proxies for the size of the banks, in order to calculate their market shares. This data come from the balance sheets of the banks, and the information is available quarterly for the period June, 1974 to June, 1990 through the *Auditoría General de Entidades Financieras*, the entity in charge of overseeing the Costa Rican financial system. Thus, a total of 65 observations will be available for those banks that existed during the whole period; however, for the majority of private banks, which entered later, the number of observations is substantially lower. These constraints in the number of observations obviously limit the tests that can be undertaken.

The use of a flow variable, such as the net change in the earning assets or total assets, to calculate the market share of the banks is a second option that must be explored. Obviously, a flow variable is more susceptible to recent changes in the industry than a stock variable[45].

The information about the regulatory environment is also managed by the *Auditoría*, and it is easily available.

The data about exogenous variables that may affect the evolution of the banking industry structure, such as the fiscal deficit, interest rates, and near moneis, corresponds to

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[45] A stock variable shows the cumulative history of the banks performance, thus, it is less sensitive to recent changes.

macroeconomic variables that are available from the Central Bank of Costa Rica. Data about the securities market to be used as a proxy for regulatory avoidance of the demand deposits regulation can be obtained from the securities market itself (*Bolsa Nacional de Valores*) and from the Central Bank.

The clustering analysis requires to regress a dependent variable reflecting performance against a vector of independent variables indicating the conduct of the firms and other exogenous events. Real earning assets or their rates of growth can be used as proxies for the variable reflecting the performance of the banks[46]. The vector of independent variables will contain two or three managed financial ratios. They can be calculated from the income statements of the banks, which are available from the *Auditoría* for every semester during the period June, 1974 to June, 1990. The vector of independent variables would also contain one macroeconomic variable (GNP, GDP, M^s) available from the Central Bank, and one structural variable such as the price of inputs (e.g., wages, and the interest rate paid by the government).

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[46] If the relative size of the banks were calculated using a flow variable such as change in earning assets, then it would be reasonable to the rate of growth of this flow variable as a proxy for performance. The direct use of a variable measuring the size of the banks as a proxy for performance seems to fit better the purposes of the investigation than other variables commonly used as proxies of performance, such as profits.

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